



**MOTOROLA**

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# MC1490

## RF/IF/Audio Amplifier

The MC1490 is an integrated circuit featuring wide-range AGC for use in RF/IF amplifiers and audio amplifiers over the temperature range,  $-40^{\circ}$  to  $+85^{\circ}\text{C}$ .

- High Power Gain: 50 dB Typ at 10 MHz  
45 dB Typ at 60 MHz  
35 dB Typ at 100 MHz
- Wide Range AGC: 60 dB Min, DC to 60 MHz
- 6.0 V to 15 V Operation, Single Polarity Supply
- See MC1350D for Surface Mount

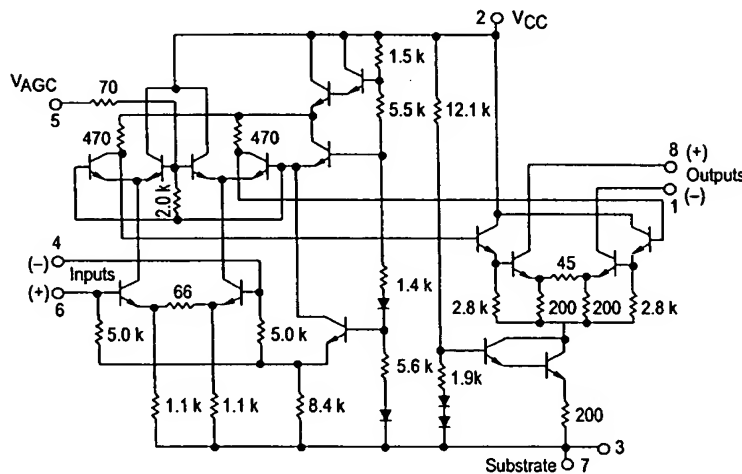
**MAXIMUM RATINGS** ( $T_A = +25^{\circ}\text{C}$ , unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	+18	Vdc
AGC Supply	$V_{AGC}$	$V_{CC}$	Vdc
Input Differential Voltage	$V_{ID}$	5.0	Vdc
Operating Temperature Range	$T_A$	$-40$ to $+85$	$^{\circ}\text{C}$
Storage Temperature Range	$T_{stg}$	$-65$ to $+150$	$^{\circ}\text{C}$
Junction Temperature	$T_J$	+150	$^{\circ}\text{C}$

### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC1490P	$T_A = -40^{\circ}$ to $+85^{\circ}\text{C}$	Plastic

### Representative Schematic Diagram



Pins 3 and 7 should both be connected to circuit ground.

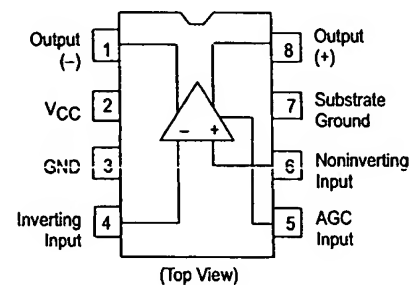
## WIDEBAND AMPLIFIER WITH AGC

### SEMICONDUCTOR TECHNICAL DATA



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 626

### PIN CONNECTIONS



### SCATTERING PARAMETERS

( $V_{CC} = +12\text{ Vdc}$ ,  $T_A = +25^{\circ}\text{C}$ ,  $Z_0 = 50\ \Omega$ )

Parameter	Symbol	f = MHz Typ		Unit
		30	60	
Input Reflection Coefficient	$ S_{11} $ 011	0.95 -7.3	0.93 -16	- deg
Output Reflection Coefficient	$ S_{22} $ 022	0.99 -3.0	0.98 -5.5	- deg
Forward Transmission Coefficient	$ S_{21} $ 021	16.8 128	14.7 64.3	- deg
Reverse Transmission Coefficient	$S_{12}$ 012	0.00048 84.9	0.00092 79.2	- deg

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## ELECTRICAL CHARACTERISTICS ( $V_{CC} = 12 \text{ Vdc}$ , $f = 60 \text{ MHz}$ , $BW = 1.0 \text{ MHz}$ , $T_A = 25^\circ\text{C}$ )

Characteristic	Figure	Symbol	Min	Typ	Max	Unit
Power Supply Current Drain	—	$I_{CC}$	—	—	17	mA
AGC Range (AGC) 5.0 V Min to 7.0 V Max	19	$M_{AGC}$	-60	—	—	dB
Output Stage Current (Sum of Pins 1 and 8)	—	$I_O$	4.0	—	7.5	mA
Single-Ended Power Gain $R_S = R_L = 50 \Omega$	19	$G_p$	40	—	—	dB
Noise Figure $R_S = 50 \text{ Ohms}$	19	NF	—	6.0	—	dB
Power Dissipation	—	$P_D$	—	168	204	mW

Figure 1. Unneutralized Power Gain versus Frequency (Tuned Amplifier, See Figure 19)

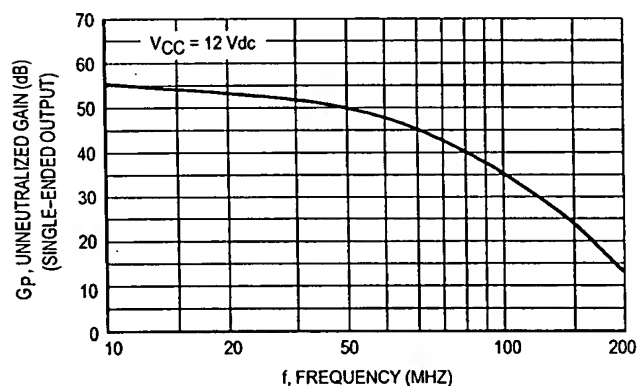


Figure 2. Voltage Gain versus Frequency (Video Amplifier, See Figure 20)

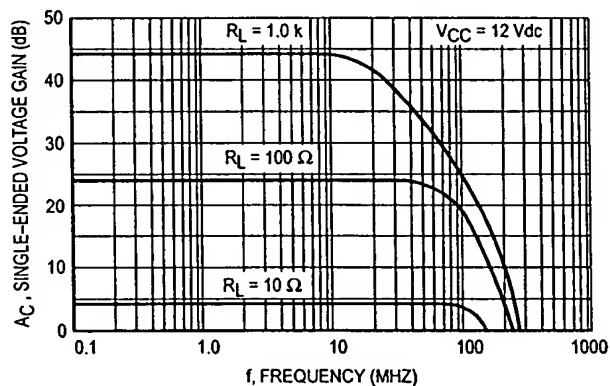


Figure 3. Dynamic Range: Output Voltage versus Input Voltage (Video Amplifier, See Figure 20)

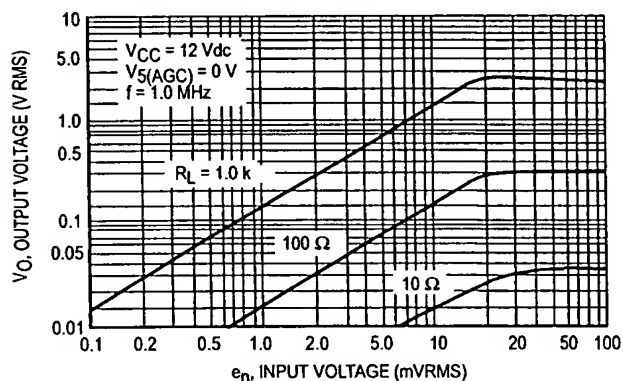
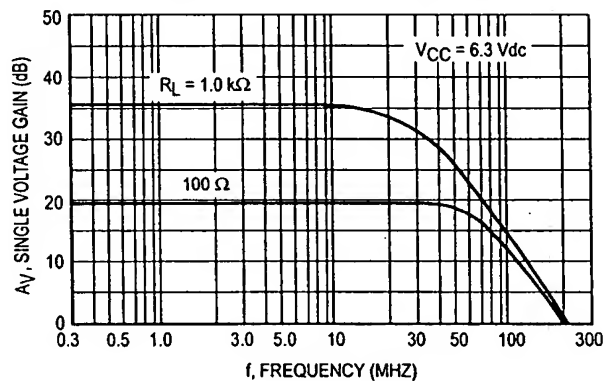
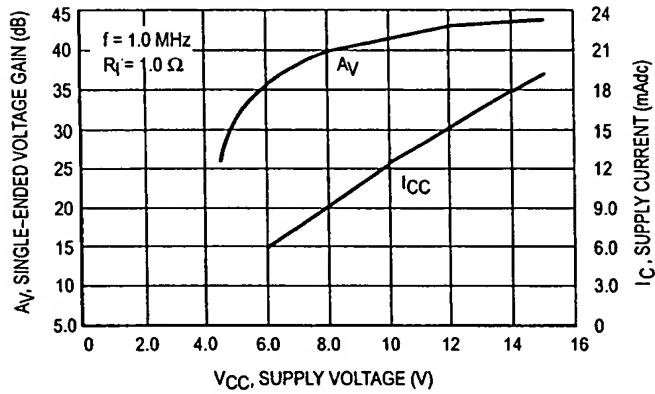


Figure 4. Voltage Gain versus Frequency (Video Amplifier, See Figure 20)

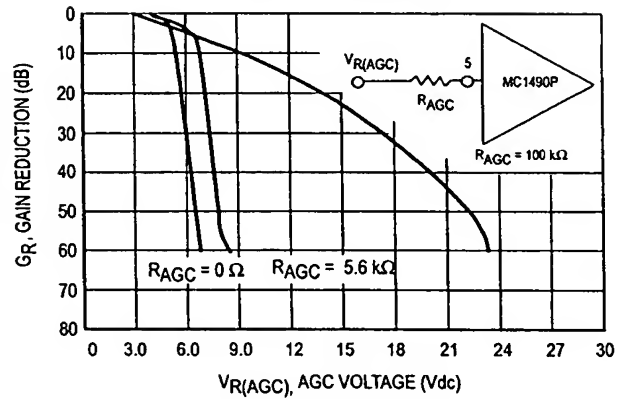


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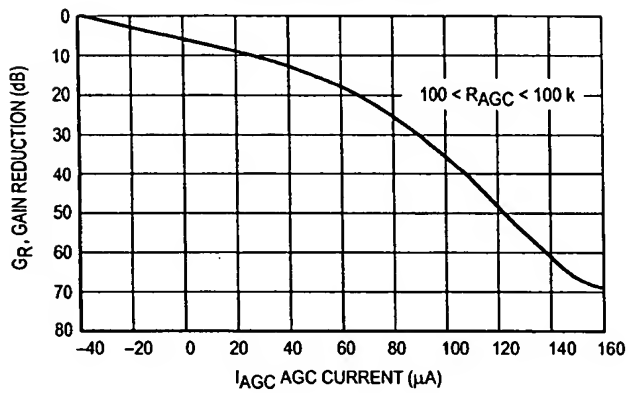
**Figure 5. Voltage Gain and Supply Current versus Supply Voltage (Video Amplifier, See Figure 20)**



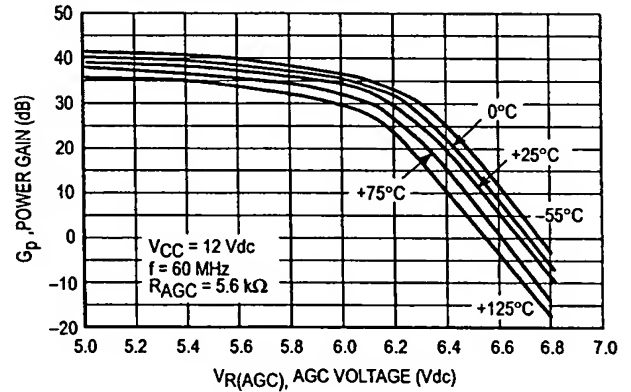
**Figure 6. Typical Gain Reduction versus AGC Voltage**



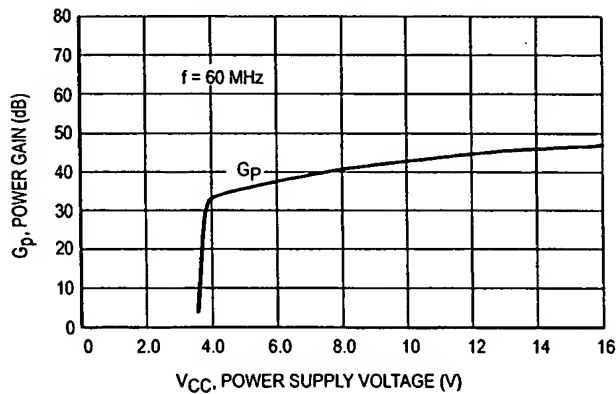
**Figure 7. Typical Gain Reduction versus AGC Current**



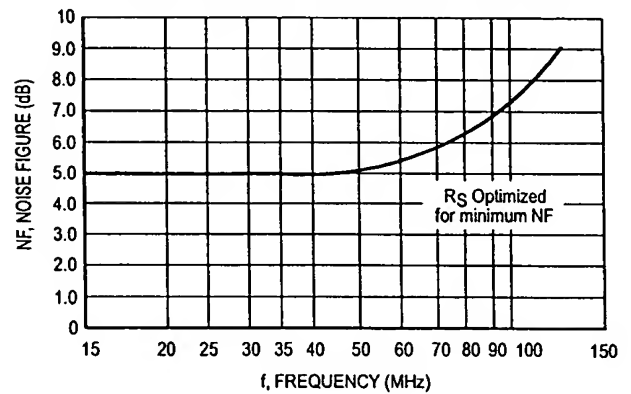
**Figure 8. Fixed Tuned Power Gain Reduction versus Temperature (See Test Circuit, Figure 19)**



**Figure 9. Power Gain versus Supply Voltage (See Test Circuit, Figure 19)**



**Figure 10. Noise Figure versus Frequency**



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Figure 11. Noise Figure versus Source Resistance

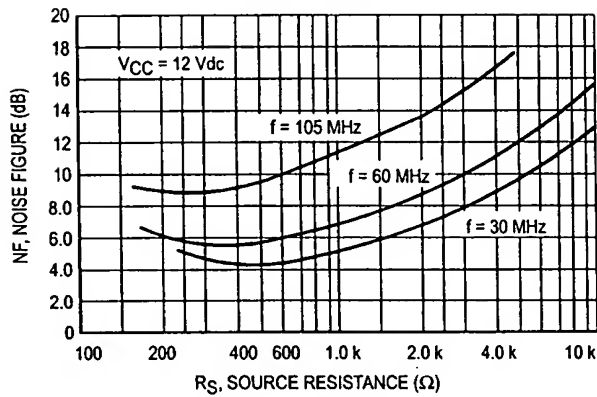


Figure 12. Noise Figure versus AGC Gain Reduction

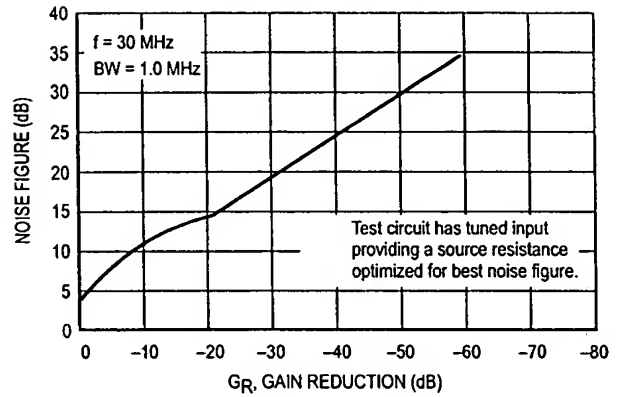


Figure 13. Harmonic Distortion versus AGC Gain Reduction for AM Carrier (For Test Circuit, See Figure 14)

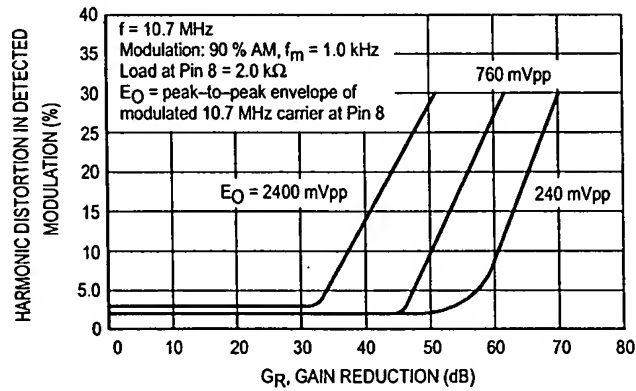
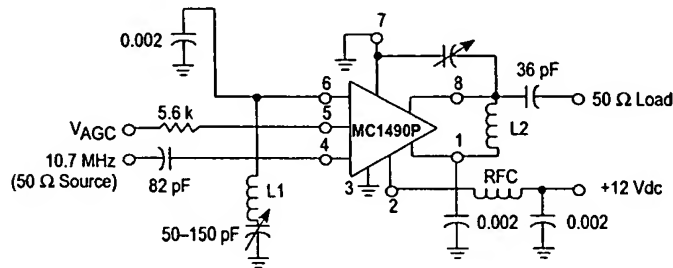


Figure 14. 10.7 MHz Amplifier Gain  $\approx 55$  dB, BW  $\approx 100$  kHz



L1 = 24 turns, #22 AWG wire on a T12-44 micro metal Toroid core ( $\sim 124$  pF)

L2 = 20 turns, #22 AWG wire on a T12-44 micro metal Toroid core ( $\sim 100$  pF)

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Figure 15.  $S_{11}$  and  $S_{22}$ , Input and Output Reflection Coefficient

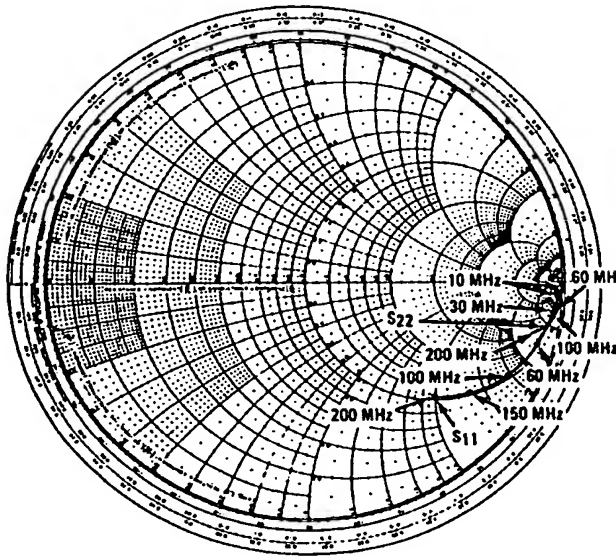


Figure 16.  $S_{11}$  and  $S_{22}$ , Input and Output Reflection Coefficient

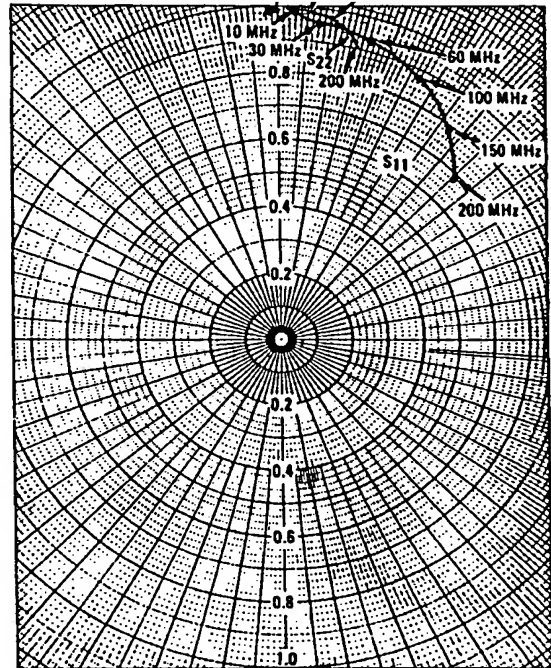


Figure 17.  $S_{21}$ , Forward Transmission Coefficient (Gain)

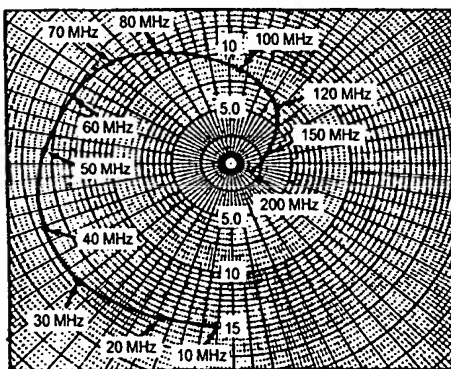
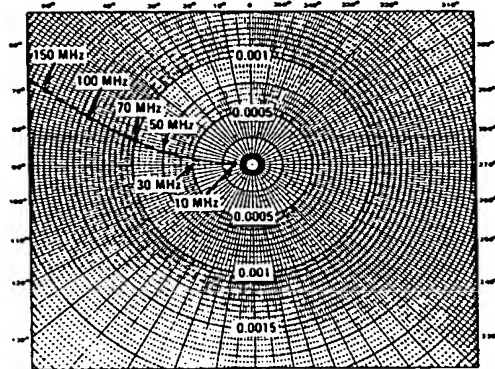
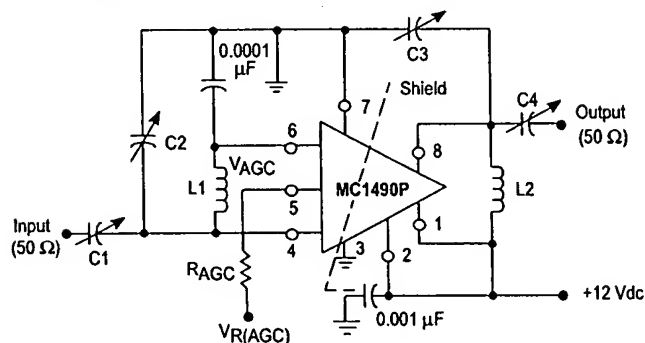


Figure 18.  $S_{12}$ , Reverse Transmission Coefficient (Feedback)



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Figure 19. 60 MHz Power Gain Test Circuit



L1 = 7 turns, #20 AWG wire, 5/16" Dia., 5/8" long  
L2 = 6 turns, #14 AWG wire, 9/16" Dia., 3/4" long  
C1, C2, C3 = (1-30) pF  
C4 = (1-10) pF

Figure 20. Video Amplifier

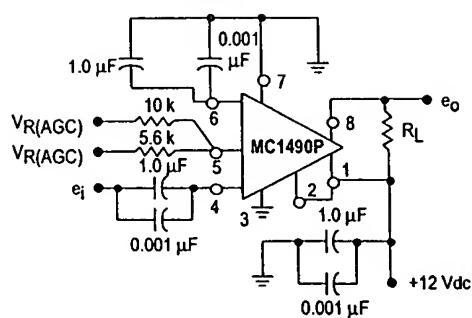
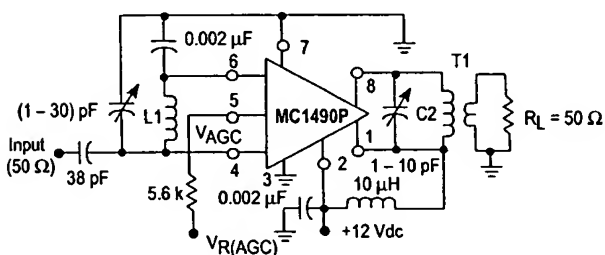
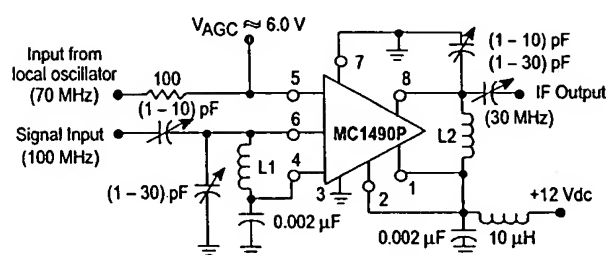


Figure 21. 30 MHz Amplifier  
(Power Gain = 50 dB, BW ≈ 1.0 MHz)



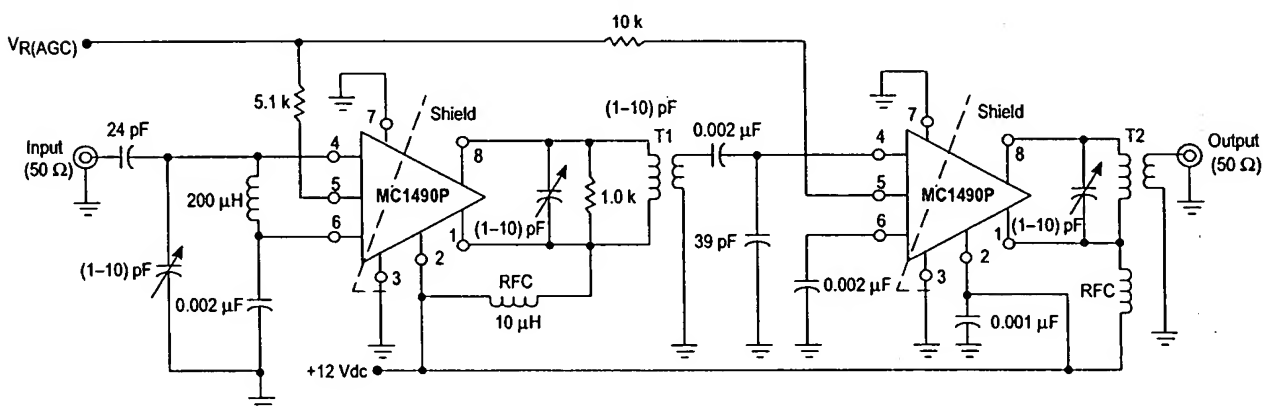
L1 = 12 turns, #22 AWG wire on a Toroid core,  
(T37-6 micro metal or equiv).  
T1: Primary = 17 turns, #20 AWG wire on a Toroid core, (T44-6).  
Secondary = 2 turns, #20 AWG wire.

Figure 22. 100 MHz Mixer



L1 = 5 turns, #16 AWG wire, 1/4", ID Dia., 5/8" long  
L2 = 16 turns, #20 AWG wire on a Toroid core, (T44-6).

Figure 23. Two-Stage 60 MHz IF Amplifier (Power Gain ≈ 80 dB, BW ≈ 1.5 MHz)



T1: Primary Winding = 15 turns, #22 AWG wire, 1/4" ID Air Core  
Secondary Winding = 4 turns, #22 AWG wire,  
Coefficient of Coupling ≈ 1.0

T2: Primary Winding = 10 turns, #22 AWG wire, 1/4" ID Air Core  
Secondary Winding = 2 turns, #22 AWG wire,  
Coefficient of Coupling ≈ 1.0

## DESCRIPTION OF SPEECH COMPRESSOR

The emitter-follower Q2 drives the AGC Pin 5 of the MC1490P and reduces the gain. R3 controls the slope of signal compression.

Frequency	Distortion		Distortion	
	10 mV $e_i$	100 mV $e_i$	10 mV $e_i$	100 mV $e_i$
100 Hz	3.5%	12%	15%	27%
300 Hz	2%	10%	6%	20%
1.0 kHz	1.5%	8%	3%	9%
10 kHz	1.5%	8%	1%	3%
100 kHz	1.5%	8%	1%	3%
	Notes 1 and 2		Notes 3 and 4	

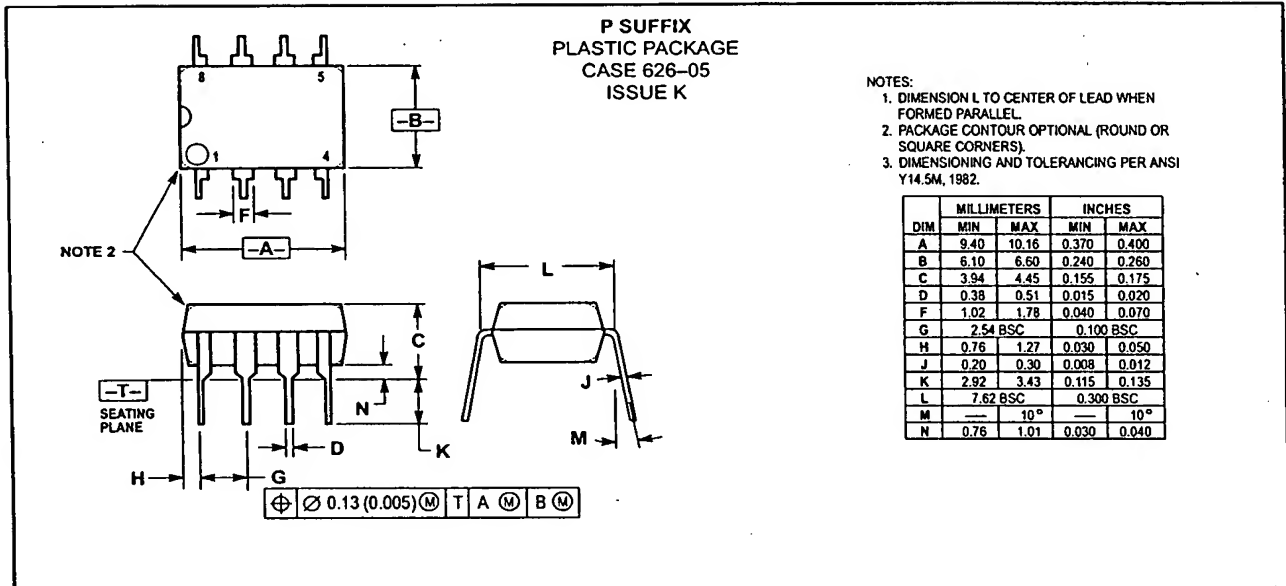
(3) Decay = 20 ms  
Attack = 3.0 ms

(4)  $C_x = 0.68 \mu\text{F}$   
 $R_x = 1.5 \text{ k}\Omega$

The circuit diagram shows a precision rectifier. The input signal is coupled through a 15 μF capacitor to the non-inverting input (pin 5) of an MC1490P op-amp. The inverting input (pin 4) is connected to a voltage divider consisting of a 15 kΩ resistor (R3) and a 15 μF capacitor, both connected to a +12 V supply. The op-amp's output (pin 1) is connected to the base of a 2N3904 transistor (Q1). The emitter of Q1 is connected to ground through a 6.8 kΩ resistor. The collector of Q1 is connected to the positive output terminal through a 2.2 kΩ resistor. A diode D1 (2N3906) is connected between the collector of Q1 and the negative output terminal. The negative output terminal is also connected to the base of another 2N3904 transistor (Q2). The emitter of Q2 is connected to ground through a 4.7 kΩ resistor. The collector of Q2 is connected to the positive output terminal through a 150 kΩ resistor. A feedback network is connected from the positive output terminal back to the inverting input (pin 4) of the op-amp, consisting of a 1.0 kΩ resistor and a 10 μF capacitor in parallel. The op-amp is powered by a +12 V supply, which is decoupled with a 25 μF electrolytic capacitor and a 0.001 μF ceramic capacitor. The negative supply is ground. A load resistor R1 (100 kΩ) is connected across the output terminals. A variable resistor R2 is connected between the collector of Q2 and the base of Q1. A capacitor Cx is connected between the base of Q2 and ground. The output voltage is labeled Vr.

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